DECLARATION

I, TAKAO OCHI, a Japanese Patent Attorney registered No. 10149, of Okabe International Patent Office at No. 602, Fuji Bldg., 2-3, Marunouchi 3-chome, Chiyoda-ku, Tokyo, Japan, hereby declare that I have a thorough knowledge of Japanese and English languages, and that the attached pages contain a correct translation into English of the priority documents of Japanese Patent Application No. 11-261065 filed on September 14, 1999 in the name of CANON KABUSHIKI KAISHA.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made, are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 16th day of March, 2006

TAKAO OCHI

PATENT OFFICE
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This is to certify that the annexed is a true copy of the following application as filed with this office.

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Applicant(s): CANON KABUSHIKI KAISHA

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Applicant's Information

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Address: 3-30-2, Shimomaruko, Ohta-ku, Tokyo

Name: CANON KABUSHIKI KAISHA

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[Inventor]
[Domicile or Residence] c/o Canon Kabushiki Kaisha
30-2, 3-chome, Shimomaruko,
Ohta-ku, Tokyo

[Name] SHIGERU KAWASAKI

[Applicant]

[Identification No.] 000001007

[Name] CANON KABUSHIKI KAISHA

[Representative] FUJIO MITARAI

[Attorney]

[Identification No.] 100085006

[Patent Attorney]

[Name] KAZUNOBU SERA

[Telephone Number] 03-5643-1611

[Elected Attorney]

[Identification No.] 100106622

[Patent Attorney]

[Name] JUNICHI WAKUTA

[Telephone Number] 03-5643-1611

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[Title of the Invention] Image Reading Apparatus

[Claim(s)]

[Claim 1] An image reading apparatus comprising:

a scanning member provided with an image sensor for reading an image of an original placed on an original mounting glass by scanning;

a control board for controlling drive of said scanning member;

a scanning drive source for driving said scanning member; and

drive transmission means for transmitting driving force of said scanning drive source,

wherein the image sensor, the scanning drive source and the drive transmission means are built in said scanning member, and

during scanning of the original by said scanning member, said scanning drive source and said control board are provided in a position where they do not mutually interfere in a direction substantially vertical to said original mounting glass.

[Claim 2] An image reading apparatus according to claim 1, further comprising:

drive transmission means for transmitting the drive of said scanning drive source to said scanning

member,

wherein said scanning member comprises said scanning drive source, and

said drive transmission means is provided in a position where it interferes with said scanning member in a direction substantially vertical to said original mounting glass.

[Claim 3] An image reading apparatus according to claim 2, further comprising a guide member for guiding the movement of said scanning member,

wherein said guide means is between said drive transmission means and said control board, and is provided in a position where it passes through substantially center of gravity of said scanning member.

[Claim 4] An image reading apparatus according to claim 3, wherein said drive transmission means, said control board and said guide means are positioned on a plane substantially in parallel with said original mounting glass.

[Claim 5] An image reading apparatus according to any one of claims 1 to 4, wherein said scanning drive source is provided with a motor of or less than 10φ.

[Claim 6] An image reading apparatus according to any one of claims 1 to 5, wherein said scanning drive source is provided with a worm gear.

[Claim 7] An image reading apparatus according to any one of claims 1 to 6, wherein an interface

connector is positioned on a side of said control board, and

at least one of the other sides of said control board is fixed by fixing means to the main body of said image reading apparatus.

[Claim 8] An image reading apparatus comprising:

a scanning member for reading an image of an original placed on an original mounting glass by scanning, wherein

a control board for controlling drive of said scanning member and a board cover for covering the control board are provided,

an interface connector is positioned on a side of said control board, and

at least one of the other side of said control board is fixed by fixing means to the main body of said image reading apparatus.

[Claim 9] An image reading apparatus according to claim 7 or 8, wherein said fixing means is one or more of screws.

[Claim 10] An image reading apparatus according to claim 9, wherein the receiving portion of said screw at said control board is so formed as to be flat.

[Claim 11] An image reading apparatus according to any one of claims 7 to 10, wherein a side of said control board on which said interface connector is mounted is positioned by fitting into with at least one

or more ribs provided on the main body of said image reading apparatus.

[Claim 12] An image reading apparatus according to claim 11, wherein the receiving portion of said rib at said control board is so formed as to be flat.

[Claim 13] An image reading apparatus according to any one of claims 1 to 12, wherein a tall part among parts mounted on said control board is positioned near the bending section of said board cover.

[Claim 14] An image reading apparatus according to any one of claims 1 to 13, wherein power consumption required to operate said image reading apparatus is within 2.5 W.

[Claim 15] An image reading apparatus according to any one of claims 1 to 14, wherein

said image reading apparatus is connected to a computer by a universal serial bus interface, and

drive power is supplied from said computer via said universal serial bus interface.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to an image reading apparatus and more particularly to an image reading apparatus capable of reading an original such as a document or a photograph, executing conversion into digital data and outputting the obtained image data,

and adapted for use for computer input.

[0002]

[Prior Art]

At first there will be explained a conventional image reading apparatus with reference to the accompanying drawings. Fig. 13 is a schematic view showing the configuration of a color image reading apparatus, and Fig. 14 is a plan view of the conventional image reading apparatus, in which same or equivalent components are represented by a same number.

[0003]

In the conventional image reading apparatus, as shown in Fig. 13, an original P is placed on an original mounting glass 100 supported by a cover 111 and an original cover 112 is then closed to press the original P to the original mounting glass 100.

[0004]

Then a reading unit 101 shown in Fig. 14 performs a scanning motion parallel to the original mounting glass 100 to read the image on the original P.

[0005]

The reading unit 101 is provided therein with LED's of three colors (R, G and B) constituting light sources for illuminating the original, an image sensor and a rod lens array for focusing the light reflected from the original P onto the photosensor elements of the image sensor.

[0006]

The light sources of three colors are turned on in succession and the image sensor reads the light of respective color reflected from the original P to execute color-separated image reading.

[0007]

In the conventional image reading apparatus, as shown in (a) of Fig. 14, the reading unit 101 is fixed to and supported by a slider 102 which is rendered slidable on a guide shaft 103 fixed to the main body of the apparatus.

[0008]

Also a belt 104 for transmitting the driving power from a motor 105, constituting scanning drive source, is fixed to the slider 102.

[0009]

The reading unit 101 is rendered capable of reciprocating scanning motion within a range of the original mounting glass 100 by the forward and reverse rotation of the motor 105. In this operation, the load torque T on the motor shaft can be simply represented as follows:

[0010]

$$T = F \times D/2 \times i \times 1/\eta$$

[0011]

wherein F: load in the axial direction, D: diameter of final pulley, i: reducing ratio, and η: mechanical

efficiency, so that the load torque T is dependent on the changing ratio.

[0012]

In case of using flat gears as in the conventional configuration, the changing ratio is represented by the ratio of teeth of the changing gears, and such ratio is generally selected within a range of about 0.1 to 0.3 because of the limitation in the external dimension of the image reading apparatus.

[0013]

For driving such apparatus, there is generally required a motor of a diameter of 40φ.

[0014]

As shown in (a) and (b) of Fig. 14, the image reading apparatus is also provided, as a constituent component, with an electric unit 106 consisting of a control board, a power source etc. These components are housed in a cover 111 supporting the original mounting glass 100.

[0015]

[Problem to be Solved by the Invention]

The above-described conventional technology is however associated with a drawback that the reduction in the dimension and thickness of the image reading apparatus is difficult to achieve.

[0016]

For example, in the prior technology shown in Figs.

13 and 14, in order to reduce the size (height in particular) of the image reading apparatus, the electric unit 106 including a driving system for driving the reading unit 101 and a control board for controlling the entire image reading apparatus is positioned outside the scanning area of the reading unit 101.

[0017]

Consequently the dimension of the apparatus is reduced in the height, but the footprint becomes larger than the scanning area by the size of the driving system and of the control board.

[0018]

Furthermore, the guide shaft 103, which is scan movement guide means of the reading unit, is provided at one edge of the reading unit 101, so there is a case where the reading unit 101 does not move smoothly at that scanning movement and behaves unnaturally, having negative impact on quality of an image read.

[0019]

Especially, during intermittent reading caused by waiting for the processing of external equipment, such as personal computer, when the scanning member repeats stop and start, quality of an image read is deteriorated more seriously.

[0020]

In addition, in the above-mentioned conventional

image reading apparatus, the image sensor is provided on the scanning member, which makes a scan movement, and the drive source, such as a motor, which makes the scanning member scan, is provided at the bottom of the main body of the image reading apparatus. Therefore, as one of factors which prevent compactization of the conventional examples, especially reducing the thickness, it has a defect that the height of the control board is high.

[0021]

Though it is possible to replace all the components mounted on the control board with surface mounted components, there will inevitably result a significant increase in the cost.

[0022]

It is also possible to suppress the height of the control board by mounting parts requiring a relatively large dimension in the height, such as electrolytic capacitors, in a flatly lying position, but there is required a certain clearance between the control board and a cover therefor in consideration of the bending of the two.

[0023]

Furthermore, the compactization is inevitably limited since there is required a certain clearance to the scanning member.

[0024]

The present invention has been obtained in consideration of the foregoing, and an object of the present invention is to provide an image reading apparatus, which can realize compactization and reduced thickness, at low cost while maintaining quality of an image read.

[0025]

[Means for Solving the Problem]

In order to achieve the above object, an image reading apparatus according to the present invention comprises a scanning member provided with an image sensor for reading an image of an original placed on an original mounting glass by scanning, a control board for controlling drive of the scanning member, a scanning drive source for driving the scanning member; and drive transmission means for transmitting driving force of the scanning drive source, wherein the image sensor, the scanning drive source and the drive transmission means are built in the scanning member, and during scanning of the original by the scanning member, the scanning drive source and the control board are provided in a position where do not mutually interfere in a direction substantially vertical to the original mounting glass.

[0026]

The present invention comprises drive transmission means for transmitting the drive of the scanning drive

source to the scanning member, wherein the scanning member comprises the scanning drive source, and the drive transmission means is provided in a position where it interferes with the scanning member in a direction substantially vertical to the original mounting glass.

[0027]

The present invention further comprises a guide member for guiding the movement of the scanning member, wherein the guide means is between the drive transmission means and the control board, and is provided in a position where it passes through substantially center of gravity of the scanning member.

[0028]

The drive transmission means, the control board and the guide means are positioned on a plane substantially in parallel with the original mounting glass.

[0029]

The scanning drive source is provided with a motor of 10φ.

[0030]

The scanning drive source is provided with a worm gear.

[0031]

An interface connector is positioned on a side of the control board, and at least one of the other sides

of the control board is fixed by fixing means to the main body of the image reading apparatus.

[0032]

The present invention comprises a scanning member for reading an image of an original placed on an original mounting glass by scanning, wherein a control board for controlling drive of the scanning member and a board cover for covering the control board are provided, an interface connector is positioned on a side of the control board, and at least one of the other side of the control board is fixed by fixing means to the main body of the image reading apparatus.

[0033]

The fixing means is one or more of screws.

[0034]

The receiving portion of the screw at the control board is so formed as to be flat.

[0035]

A side of the control board on which the interface connector is mounted is positioned by fitting into with at least one or more ribs provided on the main body of the image reading apparatus.

[0036]

The receiving portion of the rib at the control board is so formed as to be flat.

[0037]

A tall part among parts mounted on the control

board is positioned near the bending section of the board cover.

[0038]

Power consumption required to operate the image reading apparatus is within 2.5 W.

[0039]

The image reading apparatus is connected to a computer by a universal serial bus interface, and drive power is supplied from the computer via the universal serial bus interface.

[0040]

Therefore, according to the image reading apparatus of the present invention, since the scanning drive source and the control board are provided in a position where they do not mutually interfere, the footprint will not be bigger, which makes the image reading apparatus compact and thinner.

[0041]

Since the drive transmission means is provided in a position where it interferes with the scanning member in a direction substantially vertical to the original mounting glass, it is possible to avoid the situation that the size of the image reading apparatus becomes larger.

[0042]

Since the guide means is between the drive transmission means and the control board, and is

provided in a position where it passes through substantially center of gravity of the scanning member, it is possible to minimize the driving force of the scanning drive source and to scan stably so that blurring of the image is reduced and high quality of image is obtainable.

[0043]

Since the drive transmission means, the control board and the guide means are positioned on a plane substantially in parallel with the original mounting glass, it is further possible to reduce the thickness of the image reading apparatus.

[0044]

Since the scanning drive source is provided with a motor of 10φ and a worm gear, it is possible to realize large speed reducing ratio so that compactization of the drive system can further be enhanced and the thickness of the apparatus further reduced.

[0045]

Since an interface connector is positioned on a side of the control board, and at least one of the other sides of the control board is fixed by fixing means to the main body of the image reading apparatus, it is possible to correct warpage of the control board which makes it possible to fix to the main body of the image reading apparatus under the substantially flat condition. Therefore, it is possible to minimize in

height of the control board and the clearance with the scanning member so that the image reading apparatus can be made compact and minimized in thickness.

[0046]

Since the fixing means is one or more of screws, the image reading apparatus can be made compact and minimized in thickness while realizing cost reduction.

[0047]

Since the receiving portion of the screw at the control board is so formed as to be flat, it is possible to correct warpage of the control board which makes it possible to fix to the main body of the image reading apparatus.

[0048]

Since a side of the control board on which the interface connector is mounted is positioned by fitting into with at least one or more ribs provided on the main body of the image reading apparatus, it is possible to correct warpage of the control board which makes it possible to fix to the main body of the image reading apparatus under the substantially flat condition. Therefore, it is possible to minimize in height of the control board and the clearance with the scanning member so that the image reading apparatus can be made compact and minimized in thickness.

[0049]

Since the receiving portion of the rib at the

control board is so formed as to be flat, it is possible to correct warpage of the control board which makes it possible to fix to the main body of the image reading apparatus.

[0050]

Since a tall part among parts mounted on the control board is positioned near the bending section of the board cover, these parts are positioned without being influenced by warpage of the ceiling of the control cover so that there is no need to provide the processing to flat the cover ceiling of the control board. In addition, when as a tall part among parts mounted on the control board, for example, a universal electric field capacitor and memory can be used, so that while reducing costs, the height of the control cover can be reduced, thereby being able to make the image reading apparatus compact and minimize in thickness.

[0051]

Since power consumption required to operate the image reading apparatus is within 2.5 W, it is possible to drive the apparatus with low power consumption.

[0052]

Since the image reading apparatus is connected to a computer by a universal serial bus interface, and drive power is supplied from the computer via the universal serial bus interface, this eliminates the

conventional power unit and the apparatus can be operated just by connecting to the computer, thereby being able to realize cost reduction and space saving.

[0053]

[Embodiment(s)]

The present invention will be clarified in detail by preferred embodiments thereof, with reference to the accompanying drawings. However, the dimension, material, shape, relative arrangement etc. of the components in such embodiments are intended to limit the scope of the present invention unless otherwise specified.

[0054]

[First embodiment]

At first there will be explained a first embodiment of the image reading apparatus of the present invention, with reference to Figs. 1 to 5.

[0055]

Fig. 1 is a perspective view of the first embodiment of the image reading apparatus of the present invention, in a state without an upper part thereof such as an original mounting glass etc. The overview of the image reading apparatus of the present invention is similar to that shown in Fig. 13 which was referred to in the foregoing description of the prior art, and will not, therefore, be explained in further details.

[0056]

Referring to Fig. 1, a frame member 11 serving as an external cover contains following components therein. An image sensor unit 1 constituting a scanning member for reading the image of the original is provided therein with a light source for illuminating the original, a lens array for focusing the light reflected from the original onto the photosensor element of the image sensor unit 1, and an image sensor.

[0057]

The image sensor unit 1 is provided on a holder 7 which is equipped with a slider 2 and is slidably supported on a guide shaft 3 fixed to a frame member 11.

[0058]

The holder 7 is provided with a motor 5 constituting a scanning drive source for moving the image sensor unit 1 along the guide shaft 3.

[0059]

The frame member 11 incorporates a transmission mechanism such as a synchronized meshing wire 4 for transmitting the driving force of the motor 5 to the holder 7 and the image sensor unit 1.

[0060]

The synchronized meshing wire 4 is fixed at an end thereof to the frame member 11 and is supported, at a predetermined tension, at the other end by an unrepresented elastic member.

[0061]

The driving force of the motor 5 is transmitted through speed changing means 8 to a synchronized meshing pulley 14 (cf. Fig. 2) positioned at the rear side of the holder 7 and constituting drive speed changing means.

[0062]

As shown in Fig. 2, the synchronized meshing pulley 14 is so constructed as to maintain synchronized meshing with the synchronized meshing wire 4. Thus, in response to the forward or reverse rotation of the motor 5, the synchronized meshing pulley 14 executes forward or reverse rotation whereby the image sensor unit 1 executes reciprocating motion parallel to the unrepresented original mounting glass.

[0063]

In the frame member 11, there is also provided a control board 6 which is connected to a flat cable 9 constituting a control signal path for the image sensor unit 1 and the motor 5. The flat cable 9 is fixed at a part thereof to the apparatus by a fixing member 10.

[0064]

Fig. 2 is an exploded perspective view showing the image sensor unit and the holder provided in the first embodiment of the image reading apparatus of the present invention.

[0065]

The holder 7 is provided with the aforementioned motor 5, speed changing means 8, synchronized meshing pulley 14 and slider 2.

[0066]

The image sensor unit 1 is provided, across an elastic member 13 such as a spring, on the holder 7.

[0067]

On both ends of the image sensor unit 1 in the longitudinal direction thereof there are provided spacers 12 of a material of a low friction coefficient.

[0068]

The flat cable 9 constituting the control signal path is positioned between the holder 7 and the image sensor unit 1.

[0069]

The flat cable 9 is connected at an end C thereof to the control board 6 but is branched at the other end on the holder 7, and a branched end S is connected to the image sensor unit 1 while the other branched end M is connected to the motor 5.

[0070]

A portion of the flat cable 9 connected to the control board 6 is preferably positioned as close as possible to the guide shaft 3 (in the longitudinal direction of the image sensor unit 1) in order to reduce the influence of the moment to the guide shaft 3.

[0071]

Thus the image sensor unit 1 executes the scanning movement parallel to the original mounting glass while maintaining a state of a light contact thereto by the spacers 12, thereby reading the image on the original.

[0072]

In the following there will be explained the functional blocks of the image reading apparatus shown in Fig. 1, with reference to Fig. 3 which is a functional block diagram of the functions provided in the first embodiment of the image reading apparatus of the present invention.

[0073]

In Fig. 3, a chain-lined frame indicates a reading unit 15 corresponding to the scanning member, and a broken-lined frame indicates the aforementioned control board 6.

[0074]

The image reading apparatus functions by the basic functional blocks in the following manner. At first a control portion 26 drives motor drive means 27 and close coupling type image sensor drive means 17 (represented as sensor drive means in Fig. 3).

[0075]

The close coupling type image sensor drive means 17 activates the unrepresented three-color LED's in turn, thereby causing a close coupling sensor 16 to execute photoelectric conversion of the light reflected

from the original and to accumulate the corresponding charges.

[0076]

The close coupling sensor 16, close coupling type image sensor drive means 17 and three-color LED's are constructed as an integral unit, and a motor 5 moves the reading unit 15 in the sub scanning direction.

[0077]

The output signal of the close coupling sensor 16 is amplified by an amplifier 21 and then converted into a digital image signal by an A/D converter 22.

[0078]

The image signal digitized by the A/D converter 22 is subjected, in image processing means 23, to image processing such as shading correction utilizing shading data stored in a RAM 25, digital gain control and digital black correction.

[0079]

Thereafter the digital image signal is stored in a line buffer 24 and is transferred, through an interface, to an external equipment such as a personal computer.

[0080]

All these operations are executed by a control portion 26 which controls the various functional blocks based on instructions from driver means of an external equipment.

[0081]

In the following there will be explained, with reference to Figs. 4 and 5, the scanning drive system equipped in the image reading apparatus shown in Fig. 1.

[0082]

Figs. 4 and 5 are views showing the detailed configuration of the scanning drive system, equipped in the first embodiment of the image reading apparatus of the present invention and composed of the image sensor unit 1, holder 7, motor 5 and speed changing means 8.

[0083]

In the following there will be explained in detail how the driving force of the motor 5 is transmitted to the synchronized meshing wire 4.

[0084]

The driving force of the motor 5 is transmitted from a spur gear 31 (having teeth of a number Z1) constituting the drive transmission means on the motor shaft to a spur gear 32 (having teeth of a number Z2), and then transmitted to a worm gear 33 (having teeth of a number Z3) provided coaxially with the spur gear 32.

[0085]

The worm gear 33 then drives a helical gear 34 meshing therewith and further drives the synchronized meshing pulley 14 provided coaxially with the helical gear 34, from which the driving power is transmitted to the synchronized meshing wire 4.

[0086]

The load torque T' on the motor shaft can be represented as follows, in the same manner as already explained in the conventional configuration:

[0087]

$$T' = F' \times D'/2 \times i' \times 1/\eta'$$

[0088]

wherein F': load in the axial direction, D': diameter of the final pulley, i': speed reducing ratio, η': mechanical efficiency.

[0089]

The drive system of the present embodiment loses the mechanical efficiency to about half because of the use of the worm gear 33 instead of the spur gear, but the speed reducing ratio i' can be represented by $i' = Z1/(Z2 \times Z3)$ so that the load torque on the motor shaft can be made considerably small by employing a larger number of teeth in the helical gear 34.

[0090]

For example, if the load F' in the axial direction, the diameter D' of the final pulley and Z1/Z2 are same as those in the aforementioned conventional configuration but the mechanical efficiency η' and Z3 are selected as $\eta' = \eta/2$ and Z3 = 20, the load torque on the motor shaft is reduced to 1/10 in comparison with the conventional configuration.

[0091]

Consequently such system can be sufficiently

driven with a motor of a diameter of 6 to 10 mm.

[0092]

Thus, the drive system including the speed changing means 8 is made compact and is provided under the holder 7, so as to be contained as far as possible within the area of the image sensor, in order to achieve effective utilization of the space.

[0093]

The use of the worm gear 33 in the drive system as explained in the foregoing allows to achieve a large speed changing or reducing ratio within a limited space.

[0094]

Also, the use of such compact drive system allows, without changing the entire width of the apparatus, to secure a width for positioning the control board 6 within a space not interfering with the drive system under the holder 7 as shown in Fig. 4.

[0095]

In this manner it is rendered possible to eliminate the wasted space and to reduce the thickness of the apparatus without increasing the footprint of the entire apparatus.

[0096]

In addition, the guide shaft 3 constituting the guide means for guiding the movement of the image sensor unit 1 and the synchronized meshing wire 4 are positioned approximately at the center of gravity of

the image sensor 1 between the drive system and the control board 6 to minimize the necessary driving power of the drive source such as the motor 5 and to achieve stable scanning operation, whereby obtained is a high quality image without image blur.

[0097]

In the foregoing embodiment, there has been explained a configuration in which the motor 5 constituting the drive source is provided in the image sensor unit 1 constituting the scanning member, but the image reading apparatus of the present invention is not limited to such configuration and the scanning drive source may also be provided in the apparatus. Such image reading apparatus will be explained in the following with reference to Fig. 6, which is a plan view of a variation of the first embodiment of the image reading apparatus of the present invention. In Fig. 6, components equivalent to those in Fig. 1 are represented by corresponding numbers.

[0098]

In the image reading apparatus shown in Fig. 6, the control board 6 is positioned under the image sensor unit 1 and the motor 5 is provided in an upper right portion of the apparatus. Such image reading apparatus also can achieve a reduction in the thickness, though the dimension of the apparatus is somewhat redundant.

[0099]

As explained in the foregoing, in the first embodiment of the image reading apparatus of the present invention, the drive system for the image sensor unit 1 and the control board 6 are so positioned that they do not mutually interfere during the movement of the image sensor unit 1 whereby provided is a compact image reading apparatus with a reduced thickness.

[0100]

[Second embodiment]

In the following there will be explained a second embodiment of the image reading apparatus of the present invention, with reference to Figs. 7 to 9.

[0101]

However, the image reading apparatus of the second embodiment is different from that of the first embodiment in the installation structure of the control board but is same in other configurations such as the functional blocks and the structure of the scanning drive system, so that such same configurations are represented by same numbers and will not be explained further.

[0102]

Figs. 7, 8 and 9 illustrate the second embodiment of the image reading apparatus of the present invention and show the configuration of a control board with a

parallel interface (having a large interface connector) (Figs. 7 and 8) and a fixing method to the frame member (Fig. 9). More specifically, Figs. 7 and 8 show the configuration of the control board employed in the second embodiment of the present invention, and Fig. 9 shows schematic views showing a method of fixing the control board, provided in the second embodiment of the image reading apparatus, to the frame member thereof.

[0103]

In Fig. 7, there are shown a control board 71 consisting of a mounting board 71c to which an interface connector 71a for connection with the personal computer and an interface connector 71b for connection with the printer are soldered, a board cover 72 with shielding effect, and a parallel connector cover 73.

[0104]

As shown in Fig. 8, components of a larger height such as an ordinary electrolytic capacitor 84 and a RAM 85 as a memory mounted on the control board 71 are positioned close to the bent portion of the board cover 72 in order to avoid influence of eventual curvature of the ceiling part of the board cover 72.

[0105]

Also the control board 72 itself is maintained substantially flat and is prevented from curvature in the vicinity of the parallel port by the soldering of

the large parallel port.

[0106]

As shown in (a) of Fig. 9, the control board 71 is inserted from the back side of the frame member 11 and, as shown in (b) of Fig. 9, is positioned in the direction of height by a hook provided in the frame member 11 in such a manner that the height at a central portion opposite to the parallel connector becomes same as that of screw holes on both ends.

[0107]

Therefore the curvature is corrected also in a portion opposite to the parallel port, so that the control board is fixed to the frame member 11 in such a manner that the substantially entire board becomes flat.

[0108]

In the present embodiment, therefore, there is not required a flattening operation for the ceiling part of the board cover 72. Also ordinary electrolytic capacitor and memories can be employed to reduce the cost and to minimize the height of the control board 71.

[0109]

Also the apparatus can be made compact and minimized in thickness, since the entire control board 71 is prevented from curvature to minimize the clearance to the scanning member.

[0110]

As explained in the foregoing, the second

embodiment of the image reading apparatus allows to suppress the curvature of the control board 71 with a lowered cost, thereby realizing compactization and reducing in the thickness of the apparatus.

[0111]

[Third embodiment]

In the following there will be explained a third embodiment of the image reading apparatus of the present invention, with reference to Figs. 10, 11 and 12.

[0112]

However, the image reading apparatus of the third embodiment is different from that of the first embodiment in the installation structure of the control board but is same in other configurations such as the functional blocks and the structure of the scanning drive system, so that such same configurations are represented by same numbers and will not be explained further.

[0113]

Figs. 10, 11 and 12 show the configuration of a control board with an interface of universal serial bus (USB) type (having a small interface connector) (Fig. 10) and a fixing method to the frame member (Figs. 11 and 12). More specifically, Fig. 10 shows the configuration of the control board employed in the third embodiment of the present invention, and Figs. 11

and 12 are schematic views showing a method of fixing the control board, provided in the third embodiment of the image reading apparatus, to the frame member thereof.

[0114]

In Fig. 10, there are shown a control board 61 consisting of a mounting board 61c to which a USB connector 61a for connection with the personal computer is soldered.

[0115]

A board cover 62 is provided with a shielding effect. As in the second embodiment, components of a larger height such as an ordinary electrolytic capacitor 84 and a RAM 85 mounted on the control board 61 are positioned close to the bent portion of the board cover 62 in order to avoid influence of eventual curvature of the ceiling part of the board cover 62.

[0116]

The control board 61 is inserted from the upper side of the frame member 11 as shown in (a) of Fig. 11, and is fixed thereto with screws on three sides other than that of having the USB connector as shown in (b) of Fig. 11. The portions of the control board 61 for receiving three fixing screws are so formed as to be flat.

[0117]

The connector side is positioned by engaging with

a rib 81 provided on the frame member as shown in Fig. 12. The receiving portion therefor of the control board 61 is also so constructed as to be flat.

[0118]

Therefore, each side of the control board 61 is corrected for curvature, whereby the control board 61 is fixed in an entirely flat state to the frame member 11.

[0119]

In the present third embodiment, therefore, there is not required a flattening operation for the ceiling part of the board cover. Also ordinary electrolytic capacitor and memories can be employed to reduce the cost and to minimize the height of the control board 61.

[0120]

Also the apparatus can be made compact and minimized in thickness, since the entire control board 61 is prevented from curvature to minimize the clearance to the scanning member.

[0121]

In the second and third embodiments of the image reading apparatus of the present invention, the bent portion need not necessarily be provided in the board cover but may be provided in the mounting board. Also the control board need not necessarily be composed of the mounting board covered by the board cover, but may be composed of a mounting board having the above-

mentioned bent portion and lacking the board cover.

[0122]

The image sensor unit and the scanning drive system employed in the foregoing first to third embodiments are of a very low electric power consumption, so that the electric power consumption of the entire image reading apparatus in the driven state can be suppressed to 2.5 W or lower.

[0123]

Such electric power can be supplied to the peripheral equipment from the USB interface which is rapidly becoming popular in the personal computers, so that the image reading apparatus such as the scanner of the present invention, equipped with the USB interface, does not required a power supply unit as necessitated in the conventional products but can be operated by mere connection to the personal computer.

[0124]

[Effect of the Invention]

As described so far, according to the present invention, since the scanning drive source and the control board are provided in a position where they do not mutually interfere, the footprint will not be bigger, which makes the image reading apparatus compact and thinner.

[0125]

Since the guide means is between the drive

transmission means and the control board, and is provided in a position where it passes through substantially center of gravity of the scanning member, it is possible to minimize the driving force of the scanning drive source and to scan stably so that blurring of the image is reduced and high quality of image is obtainable.

[0126]

Since an interface connector is positioned on a side of the control board, and at least one of the other sides of the control board is fixed by fixing means to the main body of the image reading apparatus, it is possible to correct warpage of the control board which makes it possible to fix to the main body of the image reading apparatus under the substantially flat condition. Therefore, it is possible to minimize in height of the control board and the clearance with the scanning member so that the image reading apparatus can be made compact and minimized in thickness.

[Brief Description of the Drawings]

[Fig. 1] A perspective view of an image reading apparatus constituting a first embodiment of the present invention, in a state without an upper part thereof such as an original mounting glass.

[Fig. 2] An exploded perspective view showing an image sensor until and a holder portion in the first embodiment of the image reading apparatus.

[Fig. 3] A functional block diagram of the first embodiment of the image reading apparatus of the present invention.

[Fig. 4] A view showing detailed configuration of a scanning drive system consisting of an image sensor unit, a holder, a motor and speed reducing means and provided in the first embodiment of the image reading apparatus of the present invention.

[Fig. 5] A view showing detailed configuration of a scanning drive system consisting of an image sensor unit, a holder, a motor and speed reducing means and provided in the first embodiment of the image reading apparatus of the present invention.

[Fig. 6] A plan view of a variation of the first embodiment of the image reading apparatus of the present invention.

[Fig. 7] A perspective view showing the configuration of a control board provided in a second embodiment of the image reading apparatus of the present invention.

[Fig. 8] A perspective view showing the configuration of a control board provided in a second embodiment of the image reading apparatus of the present invention.

[Fig. 9] Perspective views showing the mode of mounting of the control board, provided in the second embodiment of the image reading apparatus, in a frame

member.

[Fig. 10] A perspective view showing the configuration of a control board provided in a third embodiment of the image reading apparatus of the present invention.

[Fig. 11] Perspective views showing the mode of mounting of the control board, provided in the third embodiment of the image reading apparatus, in a frame member.

[Fig. 12] Perspective views showing the mode of mounting of the control board, provided in the third embodiment of the image reading apparatus, in a frame member.

[Fig. 13] A schematic view showing a conventional color image reading apparatus.

[Fig. 14] A plan view of a conventional image reading apparatus.

[Description of Reference Numerals or Symbols]

1 Image sensor unit
2 Slider
3 Guide shaft
4 Synchronized meshing wire
5 Motor
6 Control board
7 Holder
8 Speed changing means
9 Flat cable

10 Fixing member

11 Frame member

12 Spacer

13 Elastic member

14 Synchronized meshing pulley

15 Reading unit

16 Close coupling sensor

17 Close coupling type image sensor drive means

21 Amplifier

22 A/D converter

23 Image processing means

24 Line buffer

25 RAM

26 Control portion

27 Motor drive means

31, 32 Spur gear

33 Worm gear

34 Helical gear

61 Control board

61a USB interface connector

61c Mounting board

62 Board cover

71 Control board

71a, 71b Interface connector

71c Mounting board

72 Board cover

73 Parallel connector cover

81 Rib

84 Electrolytic capacitor

85 RAM

100 Original mounting glass

101 Reading unit

102 Slider

103 Guide shaft

104 Belt

105 Motor

106 Electric unit

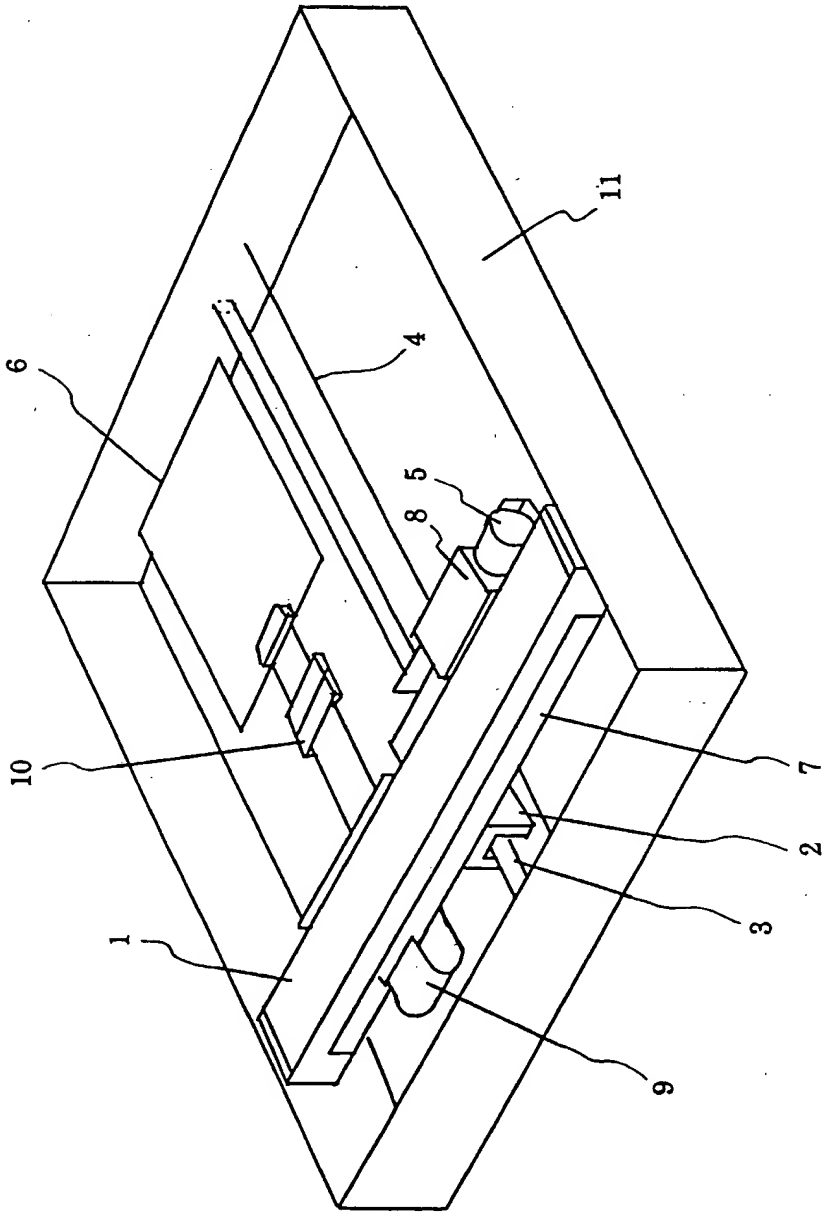
111 Cover

112 Original cover

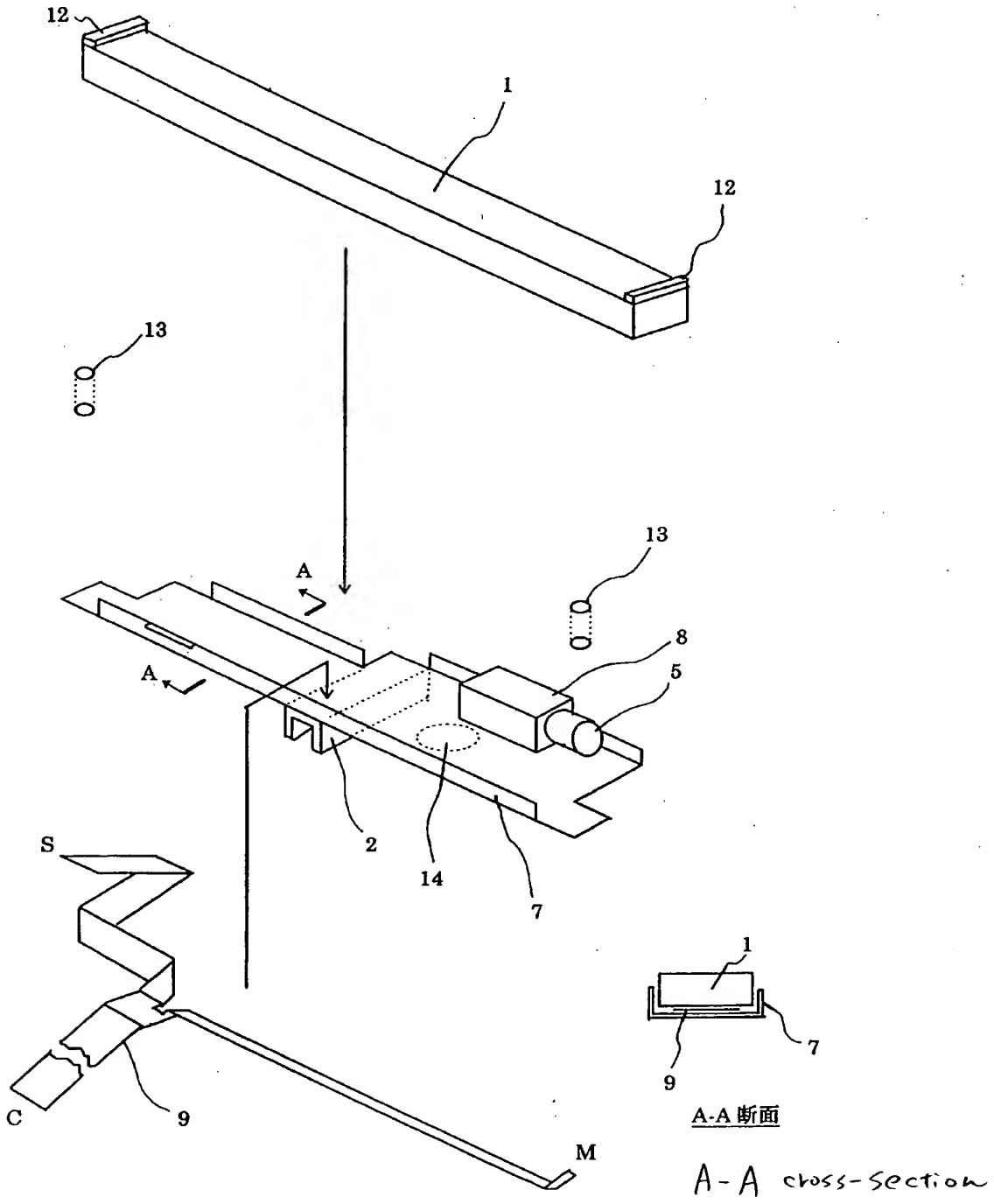
P Original

【書類名】　図面　〔Name of the Document〕 Drawings

【図１】　Fig. 1



【図２】　Fig. 2



【図３】 Fig. 3

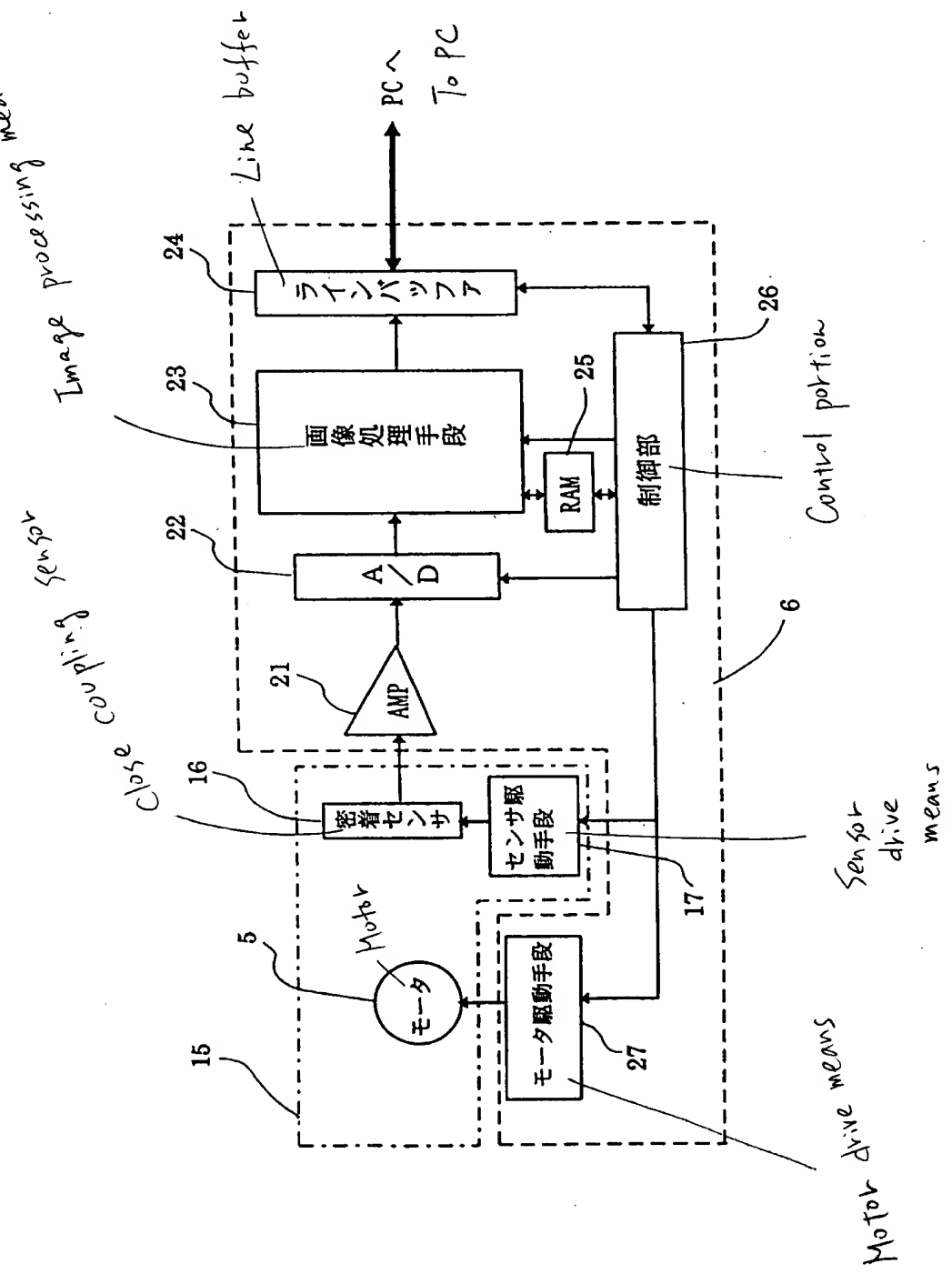
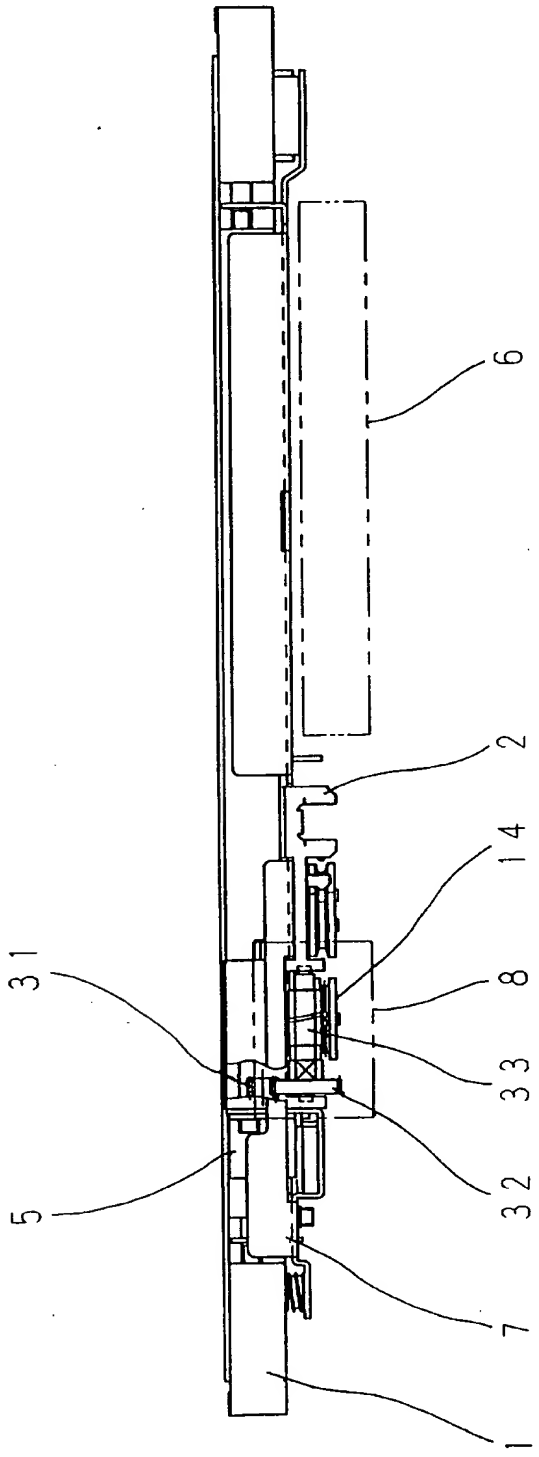
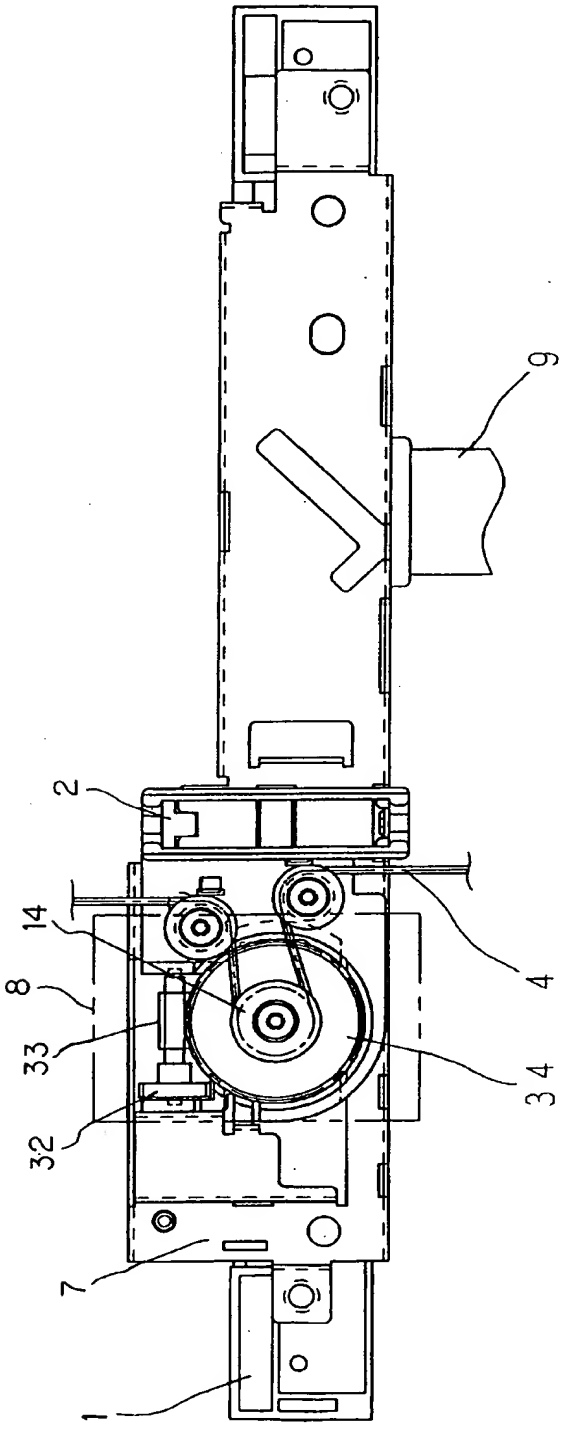


Image processing means
Line buffer
PC へ
To PC
24
ラインバッファ
23
画像処理手段
25
RAM
26
制御部
Control portion
22
A/D
Sensor coupling
21
AMP
6
Close
16
密着センサ
センサ駆動手段
17
Sensor drive means
Motor
5
モータ
モータ駆動手段
27
15
Motor drive means

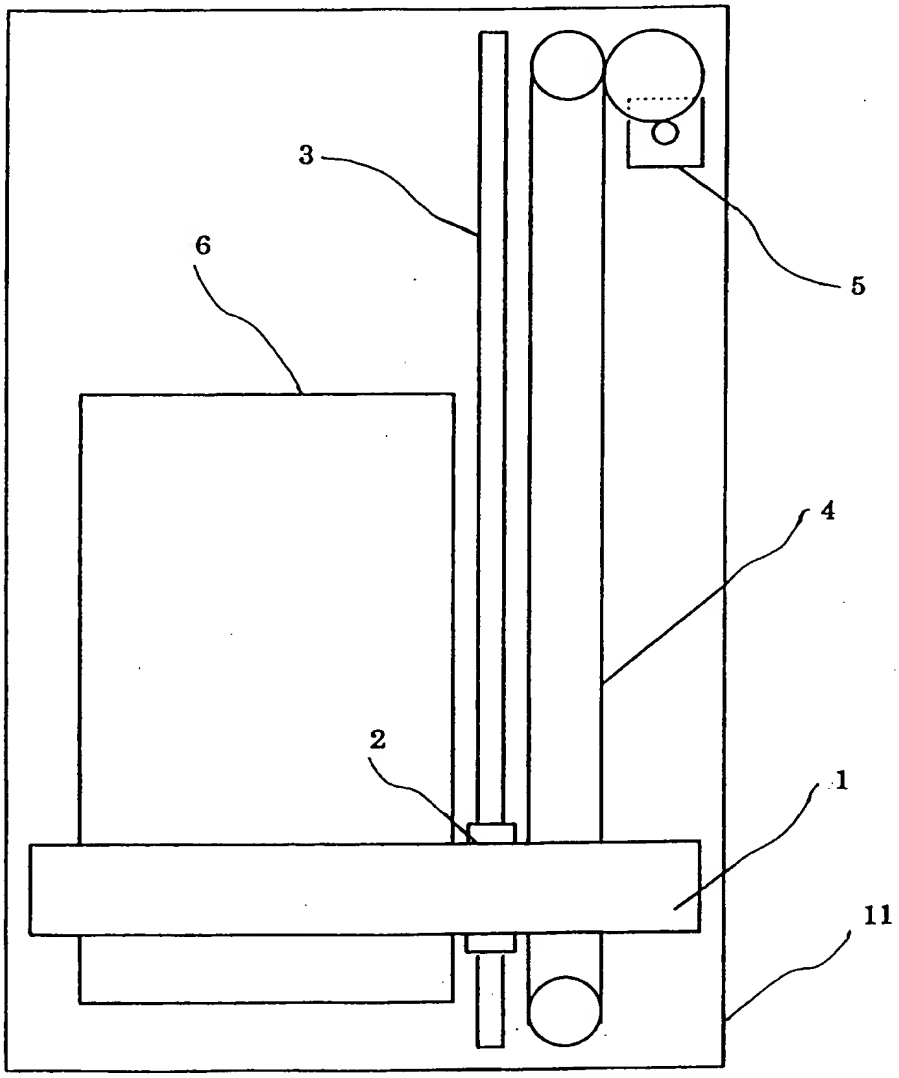
【図４】　Fig. 4



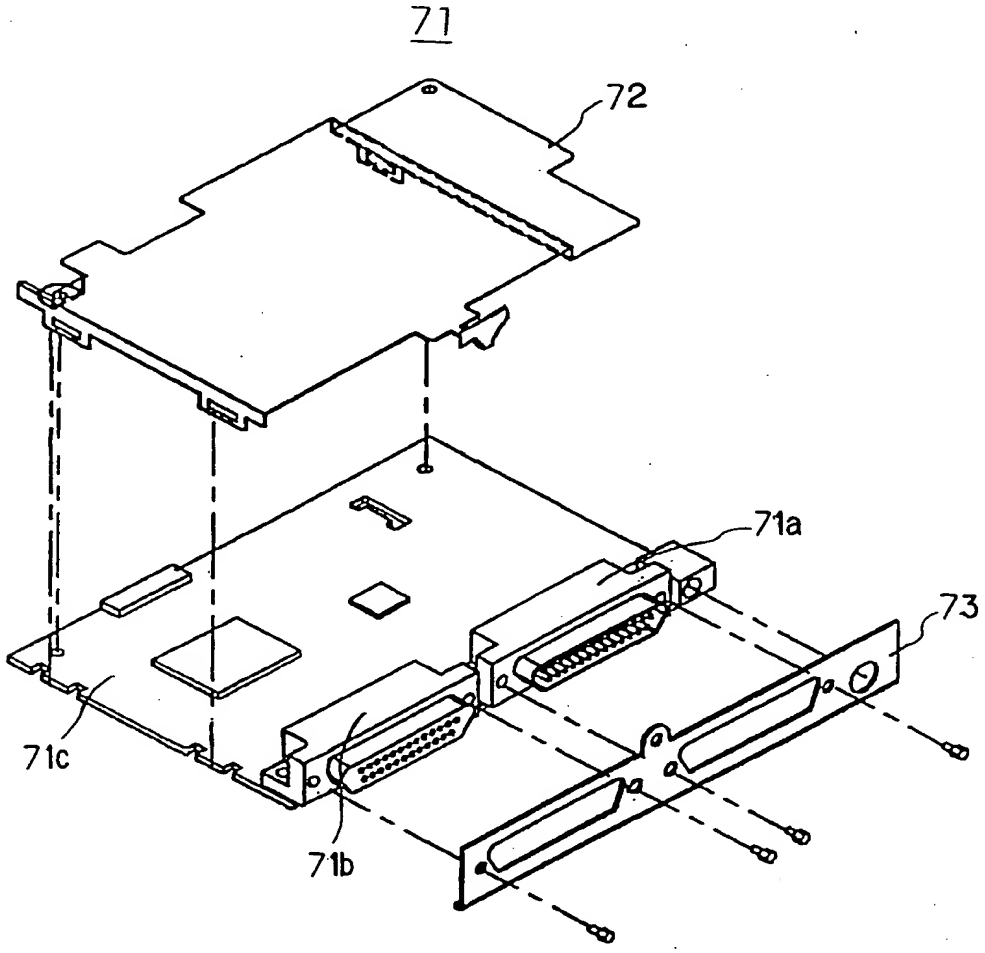
【図５】　Fig. 5



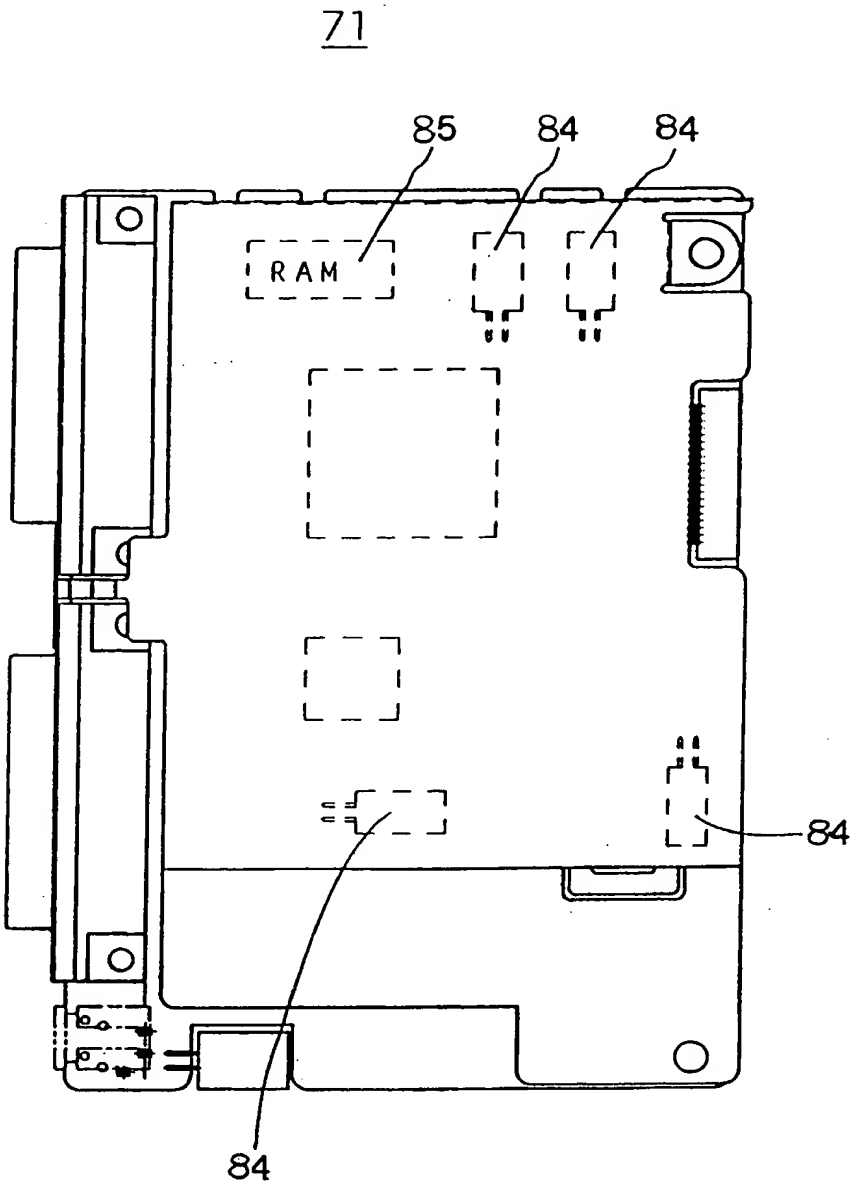
【図６】　Fig. 6



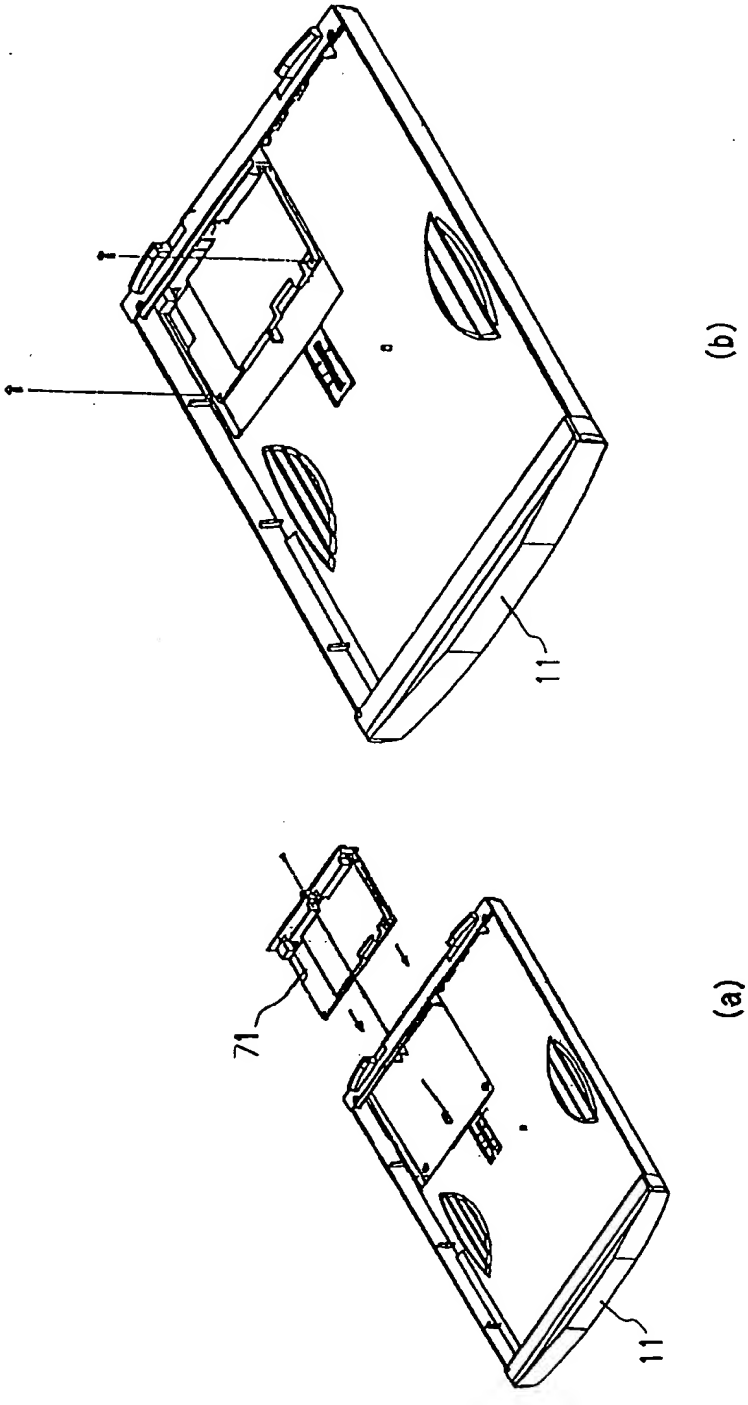
【図７】 Fig. 7



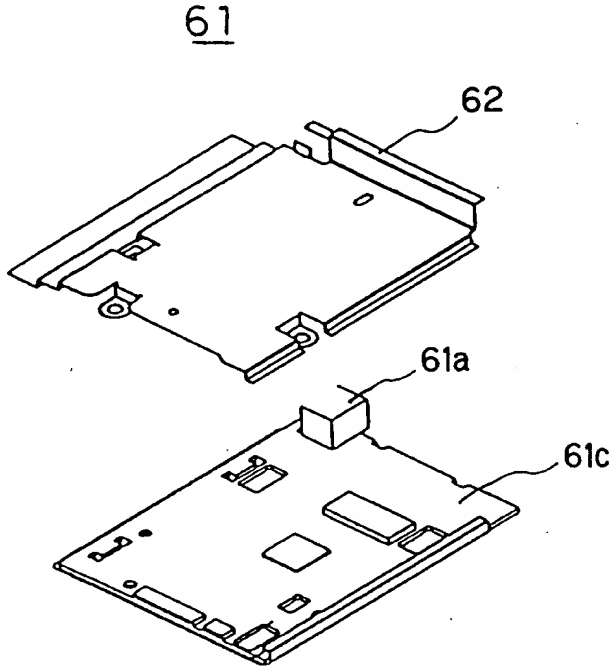
【図８】　Fig. 8



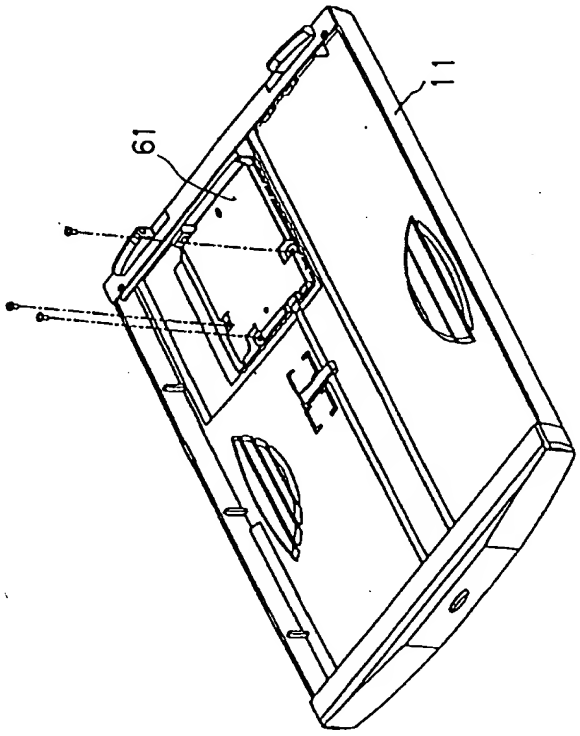
【図９】 Fig. 9



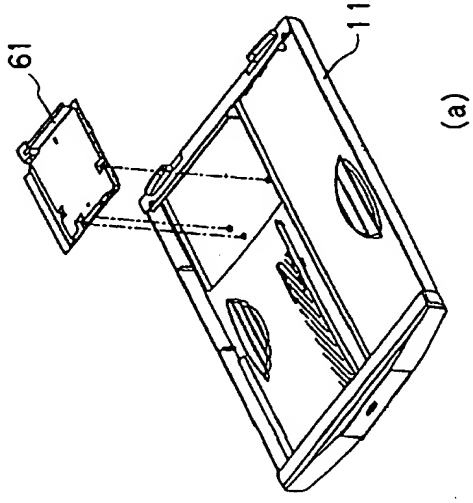
【図１０】　Fig. 10



【図１１】　Fig. 11

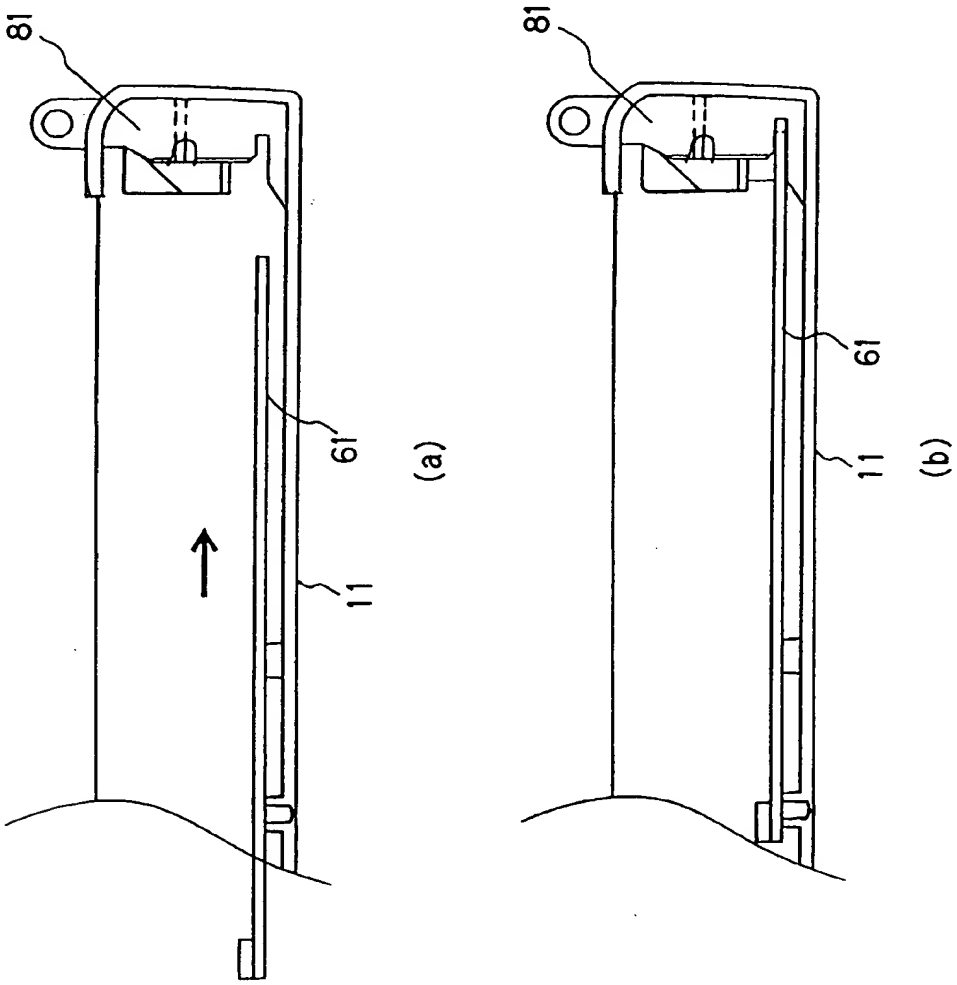


(b)

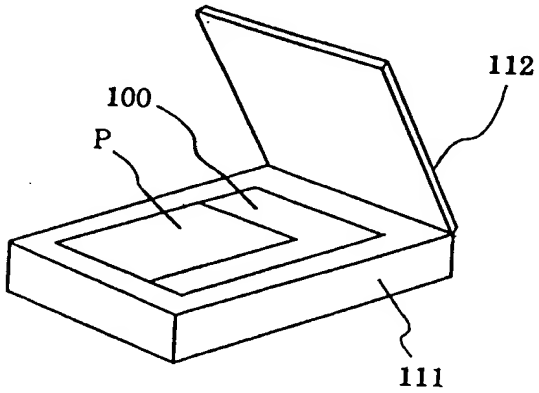


(a)

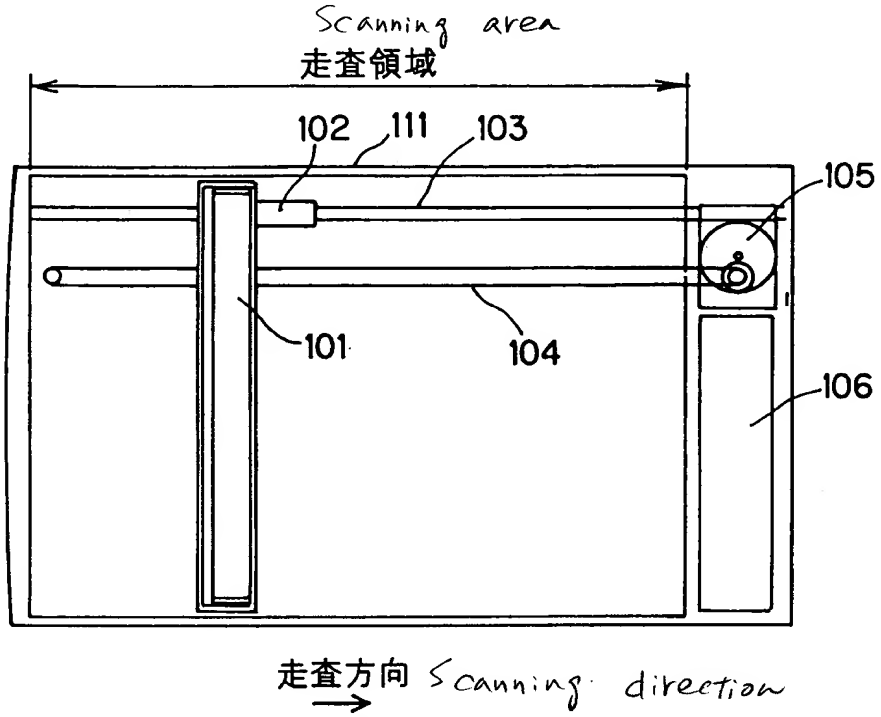
【図１２】 Fig. 12



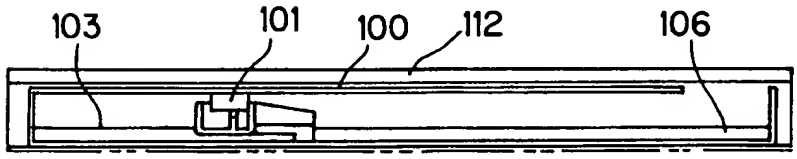
【図１３】　Fig. 13



【図１４】 Fig. 14


Scanning area
走査領域
102
111
103
105
101
104
106
走査方向 Scanning direction

(a)


103
101
100
112
106

(b)

[Name of the Document] Abstract

[Abstract]

[Problem(s)] An object of the present invention is to provide an image reading apparatus, which can realize compactization and reduced thickness, at low cost while maintaining quality of an image read.

[Means for Solving the Problem(s)] An image reading apparatus comprises an image sensor unit 1 for reading an image of an original placed on an original mounting glass by scanning, a control board 6 for controlling drive of the image sensor unit 1, and a motor 5 for driving the image sensor unit 1, wherein during scanning of the original by the image sensor unit 1, the motor 5 and the control board 6 are provided in a position where they do not mutually interfere.

[Elected Drawing] Fig. 1